Is Greenland our Arctic Ice Cap?

THE result of Dr. Nansen's journey across Greenland, establishing, as it practically does, that this Arctic continent is covered by a huge ice cap, promises to be a matter of some interest in several ways.

Among other things it may possibly yield a clue as to the cause of the south polar cap of Mars being so very excentrically placed.

Since the time of the elder Herschel this has been a subject of speculation, and various ingenious suggestions have been put forward by astronomers to account for the presumed anomaly.

Webb, in his "Celestial Objects," p. 147, tells us that Herschel found that the caps were not opposite each other; and says himself that "one would expect that they might have been diametrically opposite."

"Mädler and Secchi found the north zone concentric with the axis, but the south considerably excentric"; and "it has been suggested by Beer and Mädler that the poles of cold may not coincide with the poles of rotation."

Later on, at p. 148, he tells us that "Secchi found the appearances at the poles irreconcilable with the idea of circular caps, and was forced to adopt the supposition of complicated and lobate forms. Schiaparelli alludes to the possibility of a mass of *floating ice*."

Apparently it was taken for granted that the *ice* or snow caps of Mars, should not only be truly circular in form, but centrally placed over the axis of rotation, like the cloud caps of Jupiter and Saturn.

But it seems to me that Dr. Nansen's journey will go a long way towards solving this problem, by demonstrating that Greenland is practically one of our two polar ice caps. On our South Pole we have one, more or less centrally placed over the axis of rotation, and which certainly does not float about, having two large active volcanoes on it. It corresponds fairly well to the northern pole of Mars. But on our North Pole—as far as we can see—there is no large permanent ice cap, and in its place we have an irregular, extensive polar basin.

Roughly speaking, we may say that the character of the Arctic and Antarctic ice bears this out, for in the south we see the immense flat-topped bergs of 2000 feet thickness, and several miles long, which are obviously portions of the southern ice cap broken adrift. In the north we see a preponderance of floe, or thin field-ice, a few flat-topped bergs near Franz Joseph Land (Young), and the angular bergs of the Atlantic, mainly from West Greenland (Greely).

If our Arctic basin is deep and has few islands in it, it stands to reason that a permanant ice cap could not form, or become anchored, there; the floe would be perpetually broken up by storms and tides, carried away, and melted. A floating ice cap would be impossible. The presence of a polar continent—even excentrically placed—would seem to be necessary, as in the case of Greenland. This would indicate the solution for the supposed anomaly, *re* the position, of the south polar cap of Mars, and for the lobate appearances remarked by Secchi in 1858.

If the foregoing remarks are at all likely to be correct, Dr. Nansen's journey may have quite unexpectedly solved for us an interesting astronomical problem, and thereby afforded another clue to the condition of Mars, a proof almost of partial glaciation.

I believe that M. Fizeau regards the so-called "canals" as evidence of the "movement and rupture" of a glacial crust.

But if this crust is formed on, and attached to, any extensive *land* surface (such as Greenland, say), it is not easy to account for such enormous ruptures, and the lateral movement.

If the canals are looked on as huge lanes of open water in a floating ice-pack, they would vary in size and form almost daily.

Sibsagar, Assam, India, September 25. S. E. PEAL.

Globular and other Forms of Lightning.

MR. A. T. HARE'S account in NATURE, vol. xl. p. 415, of a flash of globular lightning seems to illustrate so well the explanation which I gave, many years ago, of the formation of fire-ball lightning, that the following extract from my pamphlet "On Atmospheric Electricity" (London, Hardwicke, Piccadilly, 1863) and the remarks which I have appended to it, may perhaps not be without interest at the present time. The pamphlet is not now on sale. The quotation is from pp. 45–46; I omit a few references:—

"A slip of tin-foil was formed into a hollow cylinder, and thrust tightly into one end of a glass tube which was about $\frac{7}{16}$ inch in external diameter, and the glass was not very thick. A brass ball was fixed to the end of the glass tube, and the tin-foil extended from the ball to the distance of about $12\frac{1}{2}$ inches from it, and all the tin-foil was inside the glass tube. The remainder of the glass tube served for an insulating support to the part which held the tin-foil. On electrifying the ball, the electricity is conveyed by the tin-foil to the inside surface of the lined part of the glass tube; and at the same moment the outside of this part of the tube is electrified inductively, and with the same sort of electricity as that with which the interior of the tube is charged. The part of the tube which held the tin-foil was supported horizontally. There was also a copper hook which could be set on any part of the outside of the lined portion of the glass tube.

"The copper hook was set at a distance of $7\frac{1}{2}$ inches from the brass ball on the end of the tube, and was connected with the outside of a Leyden-jar which was charged so as to be, nearly able to give a spark $\frac{1}{2}$ inch long between two other brass balls each of which was $1\frac{1}{4}$ inch in diameter. The knob of the jar was next brought to the ball on the end of the glass tube; the discharge readily passed over the $7\frac{1}{2}$ inches of the electrified outer surface of the glass tube. Sometimes the spark could pass when the hook was at $8\frac{1}{2}$ inches from the ball. When the hook was placed at a distance of $12\frac{3}{4}$ inches from the ball, the spark passed between the ball and the hook with a much lower charge in the jar than was necessary to produce a spark $\frac{3}{4}$ inch long between the pair of balls before mentioned.

"These experiments show that the length of an ordinary electric spark, can be much increased by causing the spark to pass over an electrified surface. Instances of this are seen in the spontaneous discharge of Leyden-jars, and in the long sparks which flash over the revolving glass of the electrical machine.

"Let a ball be attached to the prime conductor of the electrical machine so that the ball may give electrical brushes to the air. Much longer sparks may be drawn from the ball along the path of the brushes than from the other parts of the prime conductor. The brush discharge electrifies the air in the neighbourhood of the ball, and the spark is longer because it passes near to, or through, a mass of previously charged particles.

"It is well known that atmospheric electricity not unfrequently forms an electric fire-ball which moves but slowly, and which, on striking an object, explodes and produces all the usual effects of a flash of lightning. Sir William Harris writes:—'Now, it is not improbable that, in many cases in which distinct balls of fire of sensible duration have been perceived, the appearance has resulted from the species of brush or glow discharge already described, and which may often precede the main shock.' And Dr. Noad says of the electrical fire-ball that 'it is no doubt always attended by a diffusely-luminous track; this may, however, be completely eclipsed in the mind of the observer by the great concentration and density of the discharge in the points immediately through which it continues to force its way.' A more perfect explanation can, as I suppose, be given by the aid of the experiments of this chapter.

"A thunder-cloud may produce both the electric glow and the electric brush, at the end of one of its cloudy branches. And since electricity passes freely along a charged surface, therefore the glowing discharge by electrifying the air in front of the aërial conductor, adds continually to the length of the conducting column, and so the electrical fire-ball advances. Little drops of water, or any other conductive matter which the column finds in its course, must facilitate the transmission of the electricity to the fire-ball; and without doubt, too, the electricity of the column continues to spread laterally, and so it increases the conductive capacity of the column. The electricicity travels through the electrified column as a series of luminous disruptive discharges; but the light is brightest at the head, because there the diameter of the column is least, and the discharge is most closely packed; and because there the air is unelectrified, and consequently opposes so great resistance to the passage of the electricity. As soon as the fire-ball has arrived at a conducting mass on the earth, the aërial conductor has been completed, and a flash of lightning may instantly follow along the path of the fire-ball."

Since the Leyden-jar, with a charge somewhat less than that required to give a spark $\frac{1}{2}$ inch long between the $1\frac{1}{4}$-inch brass

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balls, gave a spark about 8 inches long over the excited glass tube; and since the Leyden-jar, with a charge much lower than that required to produce a spark $\frac{3}{4}$ inch long between the two brass balls, was sufficient to give a spark about 13 inches long over the excited glass tube; it was at once seen that the length of the spark over the excited glass tube, increases faster than the intensity of the charge of the Leyden-jar. Of course the law which connects the length of the spark over the excited glass tube, with the intensity of the charge of the Leyden-jar, can only be determined by experiment. It is, however, to be noticed that, from the experiments of Harris and others, the length of a spark in air of a Leyden-jar varies directly with the intensity of the charge—that is, with the quantity of electricity in the jar as measured by any such contrivance as the unit-jar. And further, that the length of the spark over the excited glass tube depends (1) on the length of the spark which the charge of the Leyden-jar can produce between the $1\frac{1}{4}$-inch brass balls; and also (2) on the degree of electrification of the glass tube; and that both these two quantities—namely, (1) and (2)—increase together. From these considerations, I should expect to find that the length of the spark over the excited glass tube increases in some way with the square of the intensity of the charge of the Leyden-jar—that is, with the square of the potential.

I dare say that the sparks over the excited glass tube, would become very brilliant by using an induction coil to charge the Leyden-jar. But to produce the maximum effect, the glass tube should, I think, be lined, as in the following experiment, with tin-filings instead of the tin-foil.

A piece of hard German glass tube was taken, and one end closed at the blow-pipe and the other end bordered to receive a cork. After these operations, the tube was found to be just 2 feet $2\frac{5}{8}$ inches long; the external diameter of the tube was $\frac{11}{16}$ inch, and the glass was $\frac{1}{20}$ inch thick. Next, the closed end of the tube was filled with tin-filings to the height of 6 inches, the filings having been condensed by tapping the end of the tube on a piece of wood. A brass rod, with a knob at one end and a screw having been cut on the other end, was screwed into a cork which nicely fitted into the glass tube, and, by means of the rod, the cork was thrust into the tube until it pressed upon the tin-filings, and since the point of the rod was sharp and projected beyond the cork, the end of the rod entered a little way into the tin-filings. The knob of the brass rod now stood just at the mouth of the glass tube, and the mouth of the tube also contained a cork through which the brass rod passed. Of the outside of the glass tube, the part surrounding the tin-filings was painted over with lac varnish, and, as soon as it became sufficiently sticky, a thin piece of tin-foil was wrapped around the tube so as to cover the tin filings, and no more. Lastly, the remaining portion of the outside of the glass tube was painted over with lac varnish. To charge this tubular Leyden-jar, it was laid with the tinned end on one conductor and with the knob of the brass rod on the other conductor of a Wimshurst influence machine. I may mention, in passing, that the capacity of this tubular Leyden-jar was surprisingly great in comparison with its size; thus showing that Leyden batteries, both cheap and compact, can be made with the aid of glass tube and metallic filings. The capacity is no doubt due, more or less, to the uniform thinness of the glass, and to the close contact of the tin-filings and the glass. The specific inductive capacity of hard German glass does not seem to have been ascertained. But of course, for the construction of Leyden-jars, and also for the plates of the Wimshurst machine, glass of the highest available specific inductive capacity should be used. It may not be amiss to remark that, owing to the high specific inductive capacity of glass as compared with air, the efficiency of a Wimshurst machine is probably much more increased by diminishing the thickness of the stratum of air between the glass plates than by diminishing the thickness of the plates.

Now, the Leyden-tube produces a class of sparks which I do not think have been shown by any other Leyden-jar. The Leyden-tube was laid, as before mentioned, on the two conductors of a Wimshurst influence machine, and the discharging balls belonging to the conductors were set $\frac{1}{2}$ inch apart. These two discharging balls were each $1\frac{3}{4}$ inch in diameter. On turning the handle of the machine, the Leyden-tube continued, of course, to become charged and then to be discharged by the $\frac{1}{2}$-inch spark between the discharging balls. But besides the main spark between the discharging balls, little streams of electricity appeared along the glass tube, and extended away from the tin-foil to a distance of $1\frac{1}{2}$ inch or more. These sparks were, I think, best seen in a subdued daylight. They were very numerous with each discharge of the tube; I estimated the number of sparks in different discharges as varying between one and two dozens. The sparks were sinuous, very bright at the tin-foil, and tapering away to nothing at the further end. Some of the sparks, however, were not so bright as the others, and rather ruddy; they were probably inside the glass tube, and coloured by the varnish on the tube.

In the *Leisure Hour*, November 1888, p. 777 (56 Paternoster Row), there is a photographic picture of a lightning-blaze, wherein the bright ends of several of the flashes are seen to be sitting upon what appears to be rock, and the flashes bear a strong resemblance to the little sparks whose bright bases rest upon the edge of the tin-foil.

In the *Leisure Hour*, November 1886, p. 786, there is another representation of a flash of lightning from a photograph. In this instance, the flash is thick in the middle, but on approaching the earth, it tapers off to a fine point. Like as a river may be only a small stream at its source and by gathering water as it leads on to the sea, become a bulky stream at its mouth; so the sparks on the Leyden-tube gather up electricity from the Leyden-tube, and so brighten away to the tin-foil. But in this flash of lightning, the very reverse appears to take place. The flash is greatly weakened before it reaches the earth, through a transverse discharge to the air. For around the brighter portions of the flash, the air is shining, and streamers are darting earthwards from the flash into the air. At the upper part of the flash, there are also streamers acting manifestly as feeders from the cloud to the flash. The flash rather resembles a long spark from the prime conductor of an electric machine, than the spark of a Leyden-jar; but the prime conductor being metallic, can only imperfectly represent the much lower conduction of a cloud.

In the *Leisure Hour*, September 1889, p. 641, there is an engraving from a photograph of the so-called ribbon-lightning. This form of lightning is clearly produced by a succession of flashes following along the same path, combined with some slight motion given to the camera by the hand of the operator; as indeed is there pointed out. The question is, How comes it that the flash so repeatedly passes along the same path? The answer there given is that suggested by Mr. Cowper Ranyard, "That apparently the first flash would heat the air and slightly rarefy it, leaving a path of least resistance, along which subsequent discharges would flow as certainly as water follows the twists and turns of a pipe." It seems to me, however, that a far more important cause for making a second flash to pass along the path of its predecessor is to be found in the action of the transverse discharge, whereby a tubular mass of air becomes electrified around the path of the first flash; and through the electrified air, the flash readily passes, as previously shown. In the woodcut, the effulgence of the surrounding air and the streamers show that the lightning was distributing electricity along its path. The transverse discharge is perhaps never absent from the flash of lightning. In NATURE, vol. xl. p. 543, a flash of lightning which struck a windmill, is described as "a mass or network of flame, which threw off thousands of sparks like fireworks."

The discharging balls of the Wimshurst machine were set one inch apart, everything else remaining as before. The sparks now extended along the glass tube to a distance of about $3\frac{1}{2}$ inches from the tin-foil. The general character of the sparks was the same as before, when the discharging balls were set half an inch apart.

The discharging balls were set $1\frac{5}{8}$ inch apart. When the discharge occurred, the sparks extended along the tube to about $5\frac{1}{2}$ inches from the tin-foil. The sparks were straighter, and not nearly so numerous as when the discharging balls were set at half an inch; they were also very much brighter, but like the others, they all tapered away to nothing. In this experiment, the Leyden-tube was charged to about the highest potential that the machine would give it; and the matter was not any further pursued. REUBEN PHILLIPS.

1 Bay View Terrace, Northam, Bideford, October 9.

"Darwinism."

WHAT my "laborious essay" "distinctly professes to be" is, as its title-page announces, "an *additional* suggestion on the origin of species"; and this additional suggestion is forthwith stated to be that of "*another factor* in the formation of species, which,

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